# PATENT SPECIFICATION

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## (54) TRUSS MANUFACTURING SYSTEM

(71) We, AUTOMATED BUILDING COMPONENTS INC., a corporation of the State of Florida, United States of America, of 7525 NW 37th Avenue, Miami, Florida, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention is concerned with an automated and centralized system for designing and fabricating building components, in particular, wood trusses. Ready access may be had over conventional telephone lines to a central computer which maintains truss data in personalized files so that the necessary information for either bidding a job or actual construction is available to truss fabricators throughout the country.

In the past fifteen years, prefabricated roof trusses for many types of structures, including residential homes, have almost completely replaced on-site nailing procedures. These trusses are monoplane configurations and include structural joints formed with multi-toothed connector plates as first disclosed in United States Patent No. 2,877,520. The connector plates are pressed into the wood joints and form a rigid unitary structure eliminating the time and labor previously expended in hand nailing each of the timbers in place.

Because of transportation costs, it is not economically feasible to truck the pre-assembled trusses completely across the country and, as a result, the trusses are pre-assembled at widely scattered locations throughout the United States and other parts of the world by what are known as truss fabricators. These fabricators are for the most part lumberyards and other relatively small business enterprises which cannot afford heavy investment in truss fabrication research and design. The problem is particularly aggravated by the fact that the fabricator is frequently called upon to bid jobs on very short notice and knowing full well that only a certain percentage of jobs bid upon will be awarded to him. Of course, those bids which are lost do not result in any compensation to the fabricator for the time and effort he has put into estimating the job and this loss must be made up in some other way if he is to stay in business.

The present invention is usable in a truss fabricating system and may make available to truss fabricators throughout the country the technological know-how and facilities of a large centralized organization. It supplies design, constructions, cost, and other data to the fabricator so that he may (1) quickly and accurately estimate a job without substantial expense so that his losses are minimized if the job is not awarded to him and (2) supplies data to him so that he may perform a job utilizing the latest and best design data and techniques from a large centralized facility.

According to the invention there is provided a method producing an engineering drawing of a truss, comprising the steps of electrically transmitting job data to a central computer from a remote user station, electrically receiving at said station from said computer computed truss manufacturing data including drawing information, converting said data to printed form, and combining said printed data with a blank having a drawing of at least a portion of a truss thereon to provide an engineering drawing.

Said blank preferably includes other indicia comprising identifying lines and spaces for dimensions and names, and such blank may be in the form of a transparent overlay arranged to overlie said printed data.

FIGURE 9 is a diagram showing typical trusses (including gable ends) which may be manufactured in accordance with the present invention;

FIGURE 10A shows a Fink truss, FIGURE 10B a double W truss (Belgian truss), and FIGURE 10C a Howe truss;

FIGURE 11A shows a full stud gable end, FIGURE 11B a triangle louver gable end. FIGURE 11C a rectangular louver gable end, FIGURE 11D a full stud dropped gable end, FIGURE 11E a triangle louver dropped gable end, and FIGURE 11F a rectangular louver dropped gable end;

FIGURE 12A shows a wedge cut bottom chord and FIGURE 12B shows a butt cut bottom chord;

FIGURE 13A shows a bottom chord splice locations at panel points for a Kingpost truss, FIGURE 13B for a Fink truss, FIGURE 13C for a Fan truss, FIGURE 13D for a Howe truss, and FIGURE 13E for a Double W (Belgian) truss;

FIGURE 14A shows top chord splice locations for equal overhangs, FIGURE 14B for unequal overhangs, FIGURE 14C for a left side spliced top chord; FIGURE 14D for a right side spliced top chord; FIGURE 14E for unequal top chords with upper members of equal length; FIGURE 14F for unequal top chords with lower members of equal length; and FIGURE 14G for all top chord members of different lengths;

FIGURES 15A, 15B, and 15C show bottom chord splice identification for two member and three member bottom chords;

FIGURE 16A shows a blank truss design input form;

FIGURE 16B shows a typically completed truss design input form;

FIGURE 17 shows a transparent overlay for an engineering drawing;

FIGURE 18 shows a typical "Teletype" readout from the central computer for use with the overlay of FIGURE 17; and

FIGURE 19 shows the completed engineering drawing produced by combining the overlay of FIGURE 17 with the "Teletype" readout of FIGURE 18.

Referring to the drawings, the system of the described embodiment is generally indicated at 10 in FIGURE 1. At 12 is a rough graphical representation of the continental United States showing a large centrally located digital computer 14 in Kansas City, Missouri. The computer 14 is shown as having a storage area or portion 16 and a processing area or portion 18, and it is connected by a high speed data transmission line 20 to a truss service facility 22 located in Charlottesville, Virginia, and by a second high speed data transmission line 24 to a second truss service facility 26 located at assignee's headquarters in Miami, Florida. Computer 14 is also illustrated in FIGURE 1 as connected by conventional telephone lines 28 to individual fabricators 30 scattered throughout the country. One such fabricator 32, who by way of example only may be located in Milwaukee, Wisconsin, is illustrated as connected through a local exchange 34 to a switching centre 36 in Chicago, Illinois, and from there by way of conventional telephone line 38 to the computer. The fabricator 32 is illustrated as having a truss design input form 40.

FIGURE 2 is a more detailed block diagram of a portion of the system illustrated in FIGURE 1. In FIGURE 2, the user terminal 30 is connected through a conventional telephone line 28 to the central computer 14. The user terminal 30 is connected through a communication computer 31 located at the site of the main computer 14. By way of example only, the communication computer 31 may be a Control Data Corporation 6411 and the main computer 14 may be one or more Control Data Corporation 6400 digital computers. The connection over telephone line 28 may be at frequencies of 110, 150 or 300 Baud using the standard ASCII "Teletype" code. The "Teletype" terminal 30 may be connected directly to the computer or through a Mobark 400T tape recorder 33 by way of a 1200 Baud line 36.

In the computer 14, a plurality of user files 37, one for each of the fabricator terminals 30, and a plurality of truss data files 39, again one for each user and corresponding to the respective user files 37. Also stored in the computer is the principal truss fabrication program 42 which is used in conjunction with the user files 37 and truss data files 39 to produce the desired information for the individual fabricators. Other portions of the computer include an output file 44 for supplying messages and accounting data to the Charlottesville, Virginia, terminal 22 and/or the Miami, Florida, terminal 26, a user's output file 46 and a scale drawing output file 48 for supplying drawing information to the Miami, Florida, terminal 26 so that sealed drawings may be prepared in Miami and forwarded by mail to the fabricator.

TABLE I.

| | | |
|---|---|---|
| 1 | SAW SET-UP EFFICENCY FACTØR | 1.00 |
| 2 | SAW RUN EFFICIENCY FACTØR | 1.00 |
| 3 | FAB SET-UP EFFICIENCY FACTØR | 1.00 |
| 4 | FAB RUN EFFICIENCY FACTØR | 1.00 |
| 5 | GE FAB EFFICIENCY FACTØR | 1.00 |
| 6 | SAW ØUTPUT FORMAT OPTIØN | 0. |
| 7 | BURDEN RATE | 2.00 |
| 8 | SAW SET LABØR RATE | 3.50 |
| 9 | SAW RUN LABØR RATE | 3.50 |
| 10 | FAB SET LABØR RATE | 3.40 |
| 11 | FAB RUN LABØR RATE | 3.30 |
| 12 | SALES TAX RATE (PER-CENT) | 4.00 |
| 13 | ZERØ ELE ØF ALPH. MARK-UP CØDE | 4.00 |
| 14 | MIN DELIVERY CHARGE | 25.00 |
| 15 | G.E. PLATE CØST/VERT. | .10 |
| 16 | DELIVERY MILEAGE RATE 1 | .55 |
| 17 | DELIVERY MILEAGE RATE 2 | .65 |
| 18 | DELIVERY MILEAGE RATE 3 | .75 |
| 19 | FIRST CHØICE PLATE TYPE | 20.00 |
| 20 | ALTERNATE PLATE TYPE | 40.00 |
| 21 | L FACTØR FØR DEFLECTIØN | 240.00 |
| 22 | TYPE ØF CUTTING EQUIPMENT | 2.00 |
| 23 | SINGLE—DØUBLE CUT WEBS | 2.00 |
| 24 | GE VERT PLATE GA.—SIZE | 723.40 |
| 25 | GE VERT. SPACING INCHES | 24.00 |
| 26 | TC LUMBER SPECIES—GRADE CØDE | 204.08 |
| 27 | BC LUMBER SPECIES—GRADE CØDE | 204.08 |
| 28 | WEB LUMBER SPECIES—GRADE CØDE | 204.02 |
| 29 | VERT LUMBER SPECIES—GRADE CØDE | 204.02 |
| 30 | NUMBER ØF ITEMS TØ APPLY S TAX | 2.00 |
| 31 | SAW 1 PØSITIVE TRAVEL 16THS | 0. |

TABLE I (Continued)

| | | |
|---|---|---|
| 63 | 2 × 3 EXACT LUMBER WIDTH | 2.50 |
| 64 | 2 × 4 EXACT LUMBER WIDTH | 3.50 |
| 65 | | 0. |
| 66 | 2 × 6 EXACT LUMBER WIDTH | 5.50 |
| 67 | | 0. |
| 68 | 2 × 8 EXACT LUMBER WIDTH | 7.25 |
| 69 | | 0. |
| 70 | 2 × 10 EXACT LUMBER WIDTH | 9.25 |
| 71 | | 0. |
| 72 | 2 × 12 EXACT LUMBER WIDTH | 11.25 |
| 73 | GN—20 PER-CENT LIST PRICE | 1.00 |
| 74 | GN—80 PER-CENT LIST PRICE | 1.00 |
| 75 | GN—40 PER-CENT LIST PRICE | 1.00 |

The second section of the user's file is a listing of the lumber the user had in stock (or is readily available to him) for the manufacture of trusses. The different species, grades, thicknesses, widths, and lengths are coded prior to putting them into the file. When so desired, the user may request a printout of his lumber file. In the following Table II is a printout of such a file as received through a "Teletype" unit:

TABLE II.

2 x 4 – 1 @ $ 77.00 NØ. 3 KD SØ.PINE
2 x 4 – 1 @ $ 77.00 NØ.2 MG MG SØ.PINE
2 x 4 – 1 @ $ 77.00 NØ.1 KD SØ.PINE
2 x 4 – 2 @ $ 77.00 NØ.3 KD SØ.PINE
2 x 4 – 2 @ $ 77.00 NØ.2 MG KD SØ.PINE
2 x 4 – 2 @ $ 77.00 NØ.1 KD SØ.PINE
2 x 4 – 3 @ $ 77.00 NØ.3 KD SØ.PINE
2 x 4 – 3 @ $ 77.00 NØ.2 MG KD SØ.PINE
2 x 4 – 3 @ $ 77.00 NØ.1 KD SØ.PINE
2 x 4 – 4 @ $ 77.00 NØ.3 KD SØ.PINE
2 x 4 – 4 @ $ 77.00 NØ.2 MG KD SØ.PINE
2 x 4 – 4 @ $ 77.00 NØ.1 KD SØ.PINE
2 x 4 – 5 @ $ 77.00 NØ.3 KD SØ.PINE
2 x 4 – 5 @ $ 77.00 NØ.2 MG KD SØ.PINE

TABLE II (Continued)

2 x 6 – 5 @ $126.00 NØ.2 MG KD SØ.PINE
2 x 6 – 6 @ $126.00 NØ.2 MG KD SØ.PINE
2 x 6 – 7 @ $131.00 NØ.2 MG KD SØ.PINE
2 x 6 – 8 @ $126.00 NØ.2 MG KD SØ.PINE
2 x 6 – 10 @ $125.00 NØ.2 MG KD SØ.PINE
2 x 6 – 10 @ $140.00 NØ.1 KD SØ.PINE
2 x 6 – 12 @ $126.00 NØ.2 MG KD SØ.PINE
2 x 6 – 12 @ $142.00 NØ.1 KD SØ.PINE
2 x 6 – 14 @ $131.00 NØ.2 MG KD SØ.PINE
2 x 6 – 14 @ $142.00 NØ.1 KD SØ.PINE
2 x 6 – 16 @ $136.00 NØ.2 MG KD SØ.PINE
2 x 6 – 16 @ $152.00 NØ.1 KD SØ.PINE
2 x 6 – 18 @ $145.00 NØ.2 MG KD SØ.PINE
2 x 6 – 18 @ $167.00 NØ.1 KD SØ.PINE
2 x 6 – 20 @ $156.00 NØ.2 MG KD SØ.PINE
2 x 6 – 20 @ $172.00 NØ.1 KD SØ.PINE
2 x 8 – 1 @ $122.00 NØ.2 MG KD SØ.PINE
2 x 8 – 2 @ $122.00 NØ.2 MG KD SØ.PINE
2 x 8 – 3 @ $122.00 NØ.2 MG KD SØ.PINE
2 x 8 – 4 @ $122.00 NØ.2 MG KD SØ.PINE
2 x 8 – 5 @ $122.00 NØ.2 MG KD SØ.PINE
2 x 8 – 6 @ $122.00 NØ.2 MG KD SØ.PINE
2 x 8 – 7 @ $122.00 NØ.2 MG KG SØ.PINE
2 x 8 – 8 @ $122.00 NØ.2 MG KD SØ.PINE
2 x 8 – 10 @ $122.00 NØ.2 MG KD SØ.PINE
2 x 8 – 12 @ $140.00 NØ.2 MG KD SØ.PINE
2 x 8 – 14 @ $139.00 NØ.2 MG KD SØ.PINE
2 x 8 – 16 @ $154.00 NØ.2 MG KD SØ.PINE
2 x 8 – 18 @ $174.00 NØ.2 MG KD SØ.PINE
2 x 8 – 20 @ $184.00 NØ.2 MG KD SØ.PINE

Another preferred feature of the system of the present invention is that it allows the user or fabricator to determine the cost of each piece of lumber in his inventory. Following in Table III is a sample of such a list with each piece calculated to the nearest one cent:

TABLE III (Continued)

| | | | |
|---|---|---|---|
| 2 × 4 – 14 | @ $145.00 = | 1.35 | NØ.1 KD SØ.PINE |
| 2 × 4 – 16 | @ $135.00 = | 1.44 | NØ.3 KD SØ.PINE |
| 2 × 4 – 16 | @ $135.00 = | 1.44 | NØ.2 MG KD SØ.PINE |
| 2 × 4 – 16 | @ $155.00 = | 1.65 | NØ.1 KD SØ.PINE |
| 2 × 4 – 18 | @ $150.00 = | 1.80 | NØ.2 MG KD SØ.PINE |
| 2 × 4 – 18 | @ $170.00 = | 2.04 | NØ.1 KD SØ.PINE |
| 2 × 4 – 20 | @ $155.00 = | 2.07 | NØ.2 MG KD SØ.PINE |
| 2 × 4 – 20 | @ $175.00 = | 2.33 | NØ.1 KD SØ.PINE |
| 2 × 6 – 1 | @ $110.00 = | .11 | NØ.2 MG KD SØ.PINE |
| 2 × 6 – 2 | @ $110.00 = | .22 | NØ.2 MG KD SØ.PINE |
| 2 × 6 – 3 | @ $110.00 = | .33 | NØ.2 MG KD SØ.PINE |
| 2 × 6 – 4 | @ $110.00 = | .44 | NØ.2 MG KD SØ.PINE |
| 2 × 6 – 5 | @ $110.00 = | .55 | NØ.2 MG KD SØ.PINE |
| 2 × 6 – 6 | @ $110.00 = | .66 | NØ.2 MG KD SØ.PINE |
| 2 × 6 – 7 | @ $110.00 = | .77 | NØ.2 MG KD SØ.PINE |
| 2 × 6 – 8 | @ $110.00 = | .88 | NØ.2 MG KD SØ.PINE |
| 2 × 6 – 10 | @ $115.00 = | 1.15 | NØ.2 MG KD SØ.PINE |
| 2 × 6 – 12 | @ $125.00 = | 1.50 | NØ.2 MG KD SØ.PINE |
| 2 × 6 – 14 | @ $125.00 = | 1.75 | NØ.2 MG KD SØ.PINE |
| 2 × 6 – 16 | @ $135.00 = | 2.16 | NØ.2 MG KD SØ.PINE |
| 2 × 6 – 18 | @ $146.00 = | 2.63 | NØ.2 MG KD SØ.PINE |
| 2 × 6 – 20 | @ $153.00 = | 3.06 | NØ.2 MG KD SØ.PINE |

Referring again to TABLE I, items 1—5 in that table are efficiency factors which use standard precalculated times as the basis for comparisons. If the fabricator has made comprehensive studies and compared them against the standard times, the factors may be changed to reflect the efficiency of the various operations in his plant. The normal efficiency factors are 1.00, i.e., 100% of standard. When an operation is below the standard, the efficiency factor should be adjusted down. When production is above the standard, the factor should be adjusted upward.

The SAW SET-UP EFFICIENCY FACTOR, listed as Item 1 in TABLE I, means that the computer has a listing of the cutting equipment the fabricator uses to cut truss members (in Item 22), and it also makes allowances for short runs and short members which are normally cut on a radial saw. The SAW RUN EFFICIENCY FACTOR (Item 2) uses standard predeveloped times for cutting truss members on the fabricator's equipment except that times are in man minutes and not in machine times. The FAB SET-UP EFFICIENCY FACTOR (Item 3) lists times for setting up the jigs and the FAB RUN EFFICIENCY FACTOR (Item 4) represents predetermined truss fabrication times, again in man minutes. Item 5 in TABLE I, i.e., GE FAB EFFICIENCY FACTOR, takes into consideration the several variables which may affect the production times of the gable ends and Item

form. Item 40, ALTERNATE WEB LUMBER CODE, is used to specify an alternate (for Item 28) lumber to be used for web members. Items 50—57 specify the longest length of lumber the user wants to use for top and bottom chords. Longer chords generally are spliced. However, in some cases, the program will override this specification if required to do so by design limitations. It may be overridden if the user specifies another lumber specification in the code box in the input form. Finally, Items 62—72 in TABLE I specify the exact widths of lumber. The actual width dimensions of the lumber the user is using are necessary in order to calculate the correct settings for the reaction pads and, in some cases, to determine the lengths of webs. The dimensions are specified in two place decimals (0.00). Items 73—75 show the three types of connector plates available and are for the user's delivered cost of each one of the types.

The lumber inventory file is illustrated in TABLE II and the lumber is listed in code by species, stress grade, width, length, and the price per 1000 board feet. There should be a listing for each length of lumber starting at 1 foot and progressing in one foot increments through 8 foot lengths and then in two foot increments to the longest length the user or fabricator carries in stock or has readily available to him. Some users may not actually purchase very short lengths, preferring to cut them from longer stock. The listing in this file must show these short lengths. Along with each listing is the price per 1000 board feet. The user's prices should include freight and a small percentage for waste. Also, in listing short members if not purchased in short lenghts, an additional percentage should be added to cover the extra cost of cutting them from longer members. The six different lumber species used for trusses are listed by grades and corresponding code numbers. The species code is the first digit of the lumber code, the next two digits are the nominal width of the lumber, the fourth and fifth digits are the nominal length of the lumber, and the last two digits are the grade code.

FIGURE 9 is a table of some of the more common trusses which may be manufactured using drawings produced by the method of the present invention. As used throughout the specification, the term trusses is intended to mean not only those devices technically referred to as trusses, but related devices such as the gable ends and dropped gable ends as illustrated. FIGURE 10A illustrates in more detail a Fink truss and illustrates critical features of the truss which must be defined in order to fabricate one. FIGURE 10B is a similar showing of a double W truss (sometimes called Belgian truss) and FIGURE 10C is a view defining critical features of a Howe truss. FIGURE 11A is a similar view of a full stud gable end, FIGURE 11B shows a gable end for a triangular louver, and FIGURE 11C shows a gable end with a space for a rectangular louver. FIGURE 11D is a similar view of a full stud dropped gable end and FIGURES 11E and 11F, respectively, show the dropped gable ends for triangular louvers and rectangular louvers.

The system of the present invention designs trusses of any span to the limits of 2 × 6 lumber and the connector plates. The actual limits for the trusses change with the pitch, stress, grades of lumber specified, percentage of allowable stress increase, and the design loads. Suggested maximum spans for Fink and Howe trusses are 46 feet 0 inches and for the double W (Belgian) trusses 60 feet 0 inches. Between limits, any pitch for the truss may be specified. The minimum and maximum limits for the Fink, Howe, and Kingpost trusses are between 1½ on 12 and 6 on 12. The minimum pitch limit for the double W (Belgian) is 2½ on 12 and the maximum is 6 on 12.

FIGURE 12A shows a truss with a wedge cut bottom chord and FIGURE 12B shows a truss with a butt cut bottom chord. Many fabricators cut the bottom chords of their trusses so that the scarf cut is blunt—blunt cut—rather than letting it cut to a full wedge of feather edge. There are occasions when the bottom chord must be built with a butt cut in order to match existing construction. A butt cut on the ends of the bottom chord requires a special setup for component cutters and for the jig.

FIGURE 13A is a schematic diagram of a kingpost truss showing code numbers for bottom chord splice locations and panel points. FIGURE 13B is a similar showing for a Fink truss and FIGURE 13C is a similar showing for a fan truss. A two-piece bottom chord may be spliced at points 31 or 32 in FIGURE 13B and 13C. FIGURE 13D is a similar view of a Howe truss. A two-piece bottom chord may be spliced at point 41, 42, or 3 in FIGURE 13D. Three-piece bottom chords may be spliced at 41 and 42, 41 and 43, or 42 and 43. It is considered not acceptable to try to splice at all panel points. FIGURE 13E shows the code

separate form with the one word END in the request number space with a wide slash across the face of the form instructs the computer to produce a recap sheet of the preceding trusses. The box labeled IDENTIFICATION in the first line is provided to help the fabricator identify this truss design (and the trusses to be produced from it) with a particular building or job. The only restriction on this is that the request number and identification both go on the same line in the program which is limited to a total of 60 places or letters, numerals, characters, and spaces for both boxes.

In the second line, the first section of the box is white. Some information must be specified. The other two sections are shaded and may be left blank if no other information is to be specified in boxes to the right of this one in line 2. The first section of the box is generally used to indicate if sales tax should or should not be added in arriving at the selling price of these trusses. The second and third sections may be used to indicate the percentage of markup which should be added to the cost of the trusses. An asterisk indicates that no sales tax is to be calculated in the selling price and a dollar sign specifies that sales tax is to be included in the selling price. The next two squares in the first box in line 2 relate to markup. If left blank, only cost will be shown in the printout. The mileage section in line 2 may be left blank or filled in as desired. The truck type section and connector plates, first choice and alternate, are believed self-explanatory from the previous description. If the truss spacing portion is left blank, the program will space the trusses on centers specified in the fabricator's user's file. If centerline spacing is specified, the program will engineer the trusses accordingly. In the saw type box, if left blank the program uses saw or component cutters designated in the fabricator's user's file. If filled in, it will indicate accordingly. Likewise, in the alternate sales tax location, if left blank the program uses the tax rate in the user's file.

In line 3, the first two boxes are white, meaning they must be filled in. If the fabricator does not need an engineering drawing of this truss, he should so indicate by entering the letters XN. If the fabricator desires a schematic drawing of this truss, which bears the seal of a professional engineer of the appropriate state, he indicates this by using the correct two-letter abbreviation for that state, such as the letters VA, shown in FIGURE 16B for the state of Virginia. The remaining boxes in line 3 are shaded and if not filled in, the appropriate information will be selected from the fabricator's user's file.

Line 4 includes several white boxes and these must be filled in. The first set is for the quantity of trusses the second set for the truss type, with the letters FI in FIGURE 16B standing for Fink truss. The remaining portions of this line are believed evident from the previous disclosure and the Slope (pitch) is always specified as two whole numbers and two decimal numbers on 12 such that the showing in FIGURE 16B stands for 6 on 12.

In line 5, the first box is white and must be filled in. This box is labeled CUT and the letter P identifies a plumb cut, whereas a letter S specifies a square cut. The same is true for the first white box in line 6. The remaining shaded boxes in lines 5 and 6 are believed readily understood from the previous description.

Referring to line 7, as previously described the program in the computer permits the use of bottom chords of 1, 2, or 3 pieces, but splices are permitted only at certain locations. Bottom chords may be spliced at panel points or in an area which is approximately $\frac{1}{4}$ of the length of the panel. If zeros are specified in white boxes in line 7, the program will select the stock length of lumber which is closest to the optimum location, but it will not use a length which is longer than the one which is specified in the user's file unless a longer length is required. Then it will override the maximum length stated in the file and specify the stock length nearest to the optimum length. If a length is specified in the input sheet as it is in FIGURE 16B, the computer will use that length if possible making the joint either in the acceptable area or at a joint. If a length is specified which is too short, i.e., does not reach the panel point, the program will override it and use a length which is nearest to the optimum length. The shaded boxes in line 7 for the center bottom chord and the bottom chord are believed readily understood from the previous description.

In line 8, the first series of six boxes are white and must be filled in. If zeroes are stated, the computer will design and calculate the truss with a one member left top chord if the fabricator's inventory file includes the length required. If a length specified is shorter than the overall length of the left chord of the truss, the computer designs and calculates a two-member top chord for the left side of the

TABLE IV.

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1
ABCØM/AUTØTRUSS

DES. NØ. 2675 A 71        DEMØNSTRATIØN

08/27/71.A—    6

    17 FI   4.50/12   25 FT   8 IN   0 SX   4/ 4

    4 HEEL   12 IN   0 SX LEFT  Ø.H
    4 HEEL   12 IN   0 SX RIGHT Ø.H.

TPI FINK TRUSS

SPACING = 24    LUM.INCR. = 1.15    PLATE INCR. = 1.15


     LL  DL  MC
TC   20  10  10   2 x 4 NØ.2 MG KD SØ.PINE          31—4
BC    0  10   8   2 x 4 NØ.2 MG KD SØ.PINE          33—0

1

RUN CØMPLETE.
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The first three lines in TABLE IV identify the job. The top line identifies it as being a truss design, line 2 lists the user's Design Number and identifying data, and the third line shows the date of the design and assignee's job number. Line 4 specifies 17 trusses, Fink type, 4.50 (4½) on 12 slope (pitch), 25 ft. 8 inches, 0 sixteenths span with a 4 inch wide top chord and a 4 inch wide bottom chord. Lines 5 and 6 specify 4/16 inch butt cut at the heel of the bottom chord and 12 inch, 0 sixteenth inch overhangs on both left and right top chords. Line 7 shows a Fink truss design in accordance with TPI criteria and line 8 shows the truss spacing is 24 inches. The allowable stress increase for lumber is 1.15 (15%) and for the connector plates 1.15 (15%). Line 9 describes the criteria for the top chord of the truss. The live load is 20 psf, the dead load is 10 psf, and the moment coefficient is 10. The moment coefficient is the part of the TPI design criteria. It is of interest to engineers, 2 × 4 #2 MG (medium grained) KD (kiln dried) southern pine is to be used for the top chord. The 31—4 at the far right indicates that 31 feet, 4 inches is the maximum span in which this lumber can be used in trusses of this design, loading and criteria. Line 10 describes the criteria for the bottom chord of the truss. There is no live load on the bottom chord, and the dead load is 10 psf. The moment coefficient is 8 and 2 × 4 MG KD southern pine is to be used in the bottom chords. The maximum span for which this lumber can be used in trusses of the same design and criteria is 33 feet, 0 inches. This completes the information in this division. All this information is of interest to the engineer estimator and should be kept with the job file.

TABLE V shows another section of the computer printout:

the selling price to cover the cost of sales, general and administrative expenses and profit. This division of the output would probably be needed in the master file and in the Estimating Department and the Cost Accounting Department.

The printout shown in TABLE VI is for the description of the production information:

ABCØM/AUTØTRUSS

DESIGN REQUEST NØ. 2675 A 71 DEMONSTRATION

71/08/06.

17 FI 4.50/12 25 FT 8 IN 0 SX 4/ 4

4 HEEL 12 IN 0 SX LEFT Ø.H.
4 HEEL 12 IN 0 SX RIGHT Ø.H.

**** LUMBER REQUISITIØN ****

34 2 x 4 – 16 TC A NØ.2 MG KD SØ.PINE

17 2 x 4 – 10 BC A NØ.2 MG KD SØ.PINE

17 2 x 4 – 16 BC B NØ.2 MG KD SØ.PINE

34 2 x 4 – 7 WEB A NØ.3 KD SØ.PINE

34 2 x 4 – 4 WEB B NØ.3 KD SØ.PINE

**** CUTTING BILLS ****

CUTTING SPECIFICATIØNS

** WEBS DØUBLE CUT **

(continued)

to run. SAW RUN is the standard time, in man/minutes, for the sawyer and his helper to cut the members. The sawyer and shop superintendent will both probably need the cutting information. The standard times may be cut from the sawyer's copy, if desired.

The jig setup instructions show where each of the reaction pads should be positioned. Dimensions are shown in feet, inches, and eighths of an inch. This agrees with the measuring tapes in the jigs which are marked in eighths. A plus (+) sign indicates the pointer on the pad should be moved beyond the mark (1/16"). Only the 1/4 point indicates vertical (V) and horizontal (H) measurements because it is the only pad for this truss which requires two measurements.

The last part of the output shows the total standard times for setting the component cutter, cutting the truss members, setting the jig and fabricating the trusses. All times are shown in man/minutes. This gives the shop superintendent, cost accountant and others an easy method of checking actual times against the standards.

It is apparent from the above that the present invention provides an improved system in which the engineering and other facilities of a large centralized organization are available to particularly small fabricators scattered throughout the country. This information is immediately available to the fabricator from a large central computer, preferably located in Kansas City, on a time-sharing basis. Connections to assignee's facilities at Charlottesville, Virginia, and Miami, Florida, make it possible to produce sealed drawings on demand and further make it possible to continuously update the computer program so that the very latest design data and techniques are provided by the computer. Each file is unique to the fabricator and under his exclusive control at all times so that no fabricator has access to the user file of any other fabricator. Thus, all his information stored in the central computer or supplied by him from his terminal is kept in strict confidence. If the fabricator requests a "bid only" report, he is simply given summarized figures which make it possible to immediately bid on jobs with minimum expenditure of time and effort. A single typewritten page serves as a sufficient input to the "Teletype" terminal at his site for supplying all information necesary to the computer to produce a full readout. By inserting in the computer program suitable instructions, the fabricator is able to obtain a printout format for a drawing which can be combined with overlays which he has available to produce engineering drawings at his own location in addition to the sealed drawings which are available from Miami. With all the data received from the computer, the fabricator may proceed with the immediate construction and delivery of the trusses with the assurance that the estimated price is accurate and provides him with accurate profit for the job.

WHAT WE CLAIM IS:—

1. A method of producing an engineering drawing of a truss, comprising the steps of electrically transmitting job data to a central computer from a remote user station, electrically receiving at said station from said computer computed truss manufacturing data including drawing information, converting said data to printed form, and combining said printed data with a blank having a drawing of at least a portion of a truss thereon to provide an engineering drawing.

2. A method according to claim 1 in which said blank includes other indicia comprising identifying lines and spaces for dimensions and names.

3. A method according to claim 1 or 2 in which said blank is in the form of a transparent overlay arranged to overlie said printed data.

4. A method according to claim 3 in which said printed data include a pair of registry marks for aligning said data with said overlay.

5. A method according to any of the preceding claims in which said electrical data transmission is effected by telegraphy.

6. A method according to any of the preceding claims in which said printed data includes one or more of the following:—

(a) truss design and manufacturing cost data;
(b) a lumber inventory;
(c) efficiency and cost factors;
(d) a cutting bill with cutting specifications;
(e) connector plate jig setup instructions.

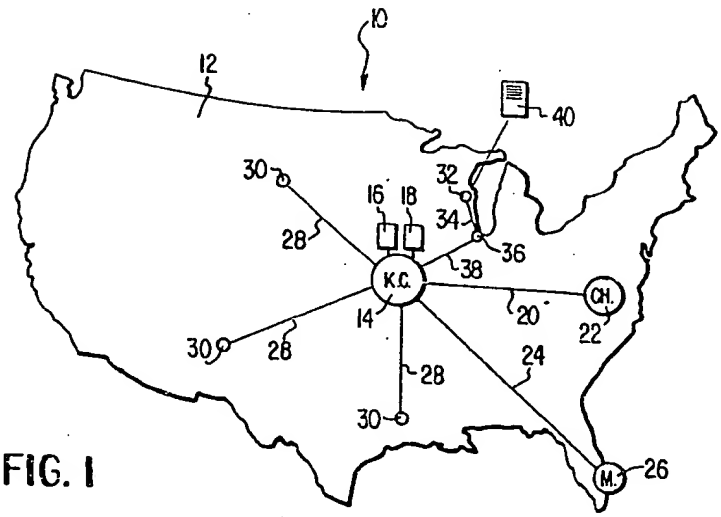



FIG. 1

FIG. 3

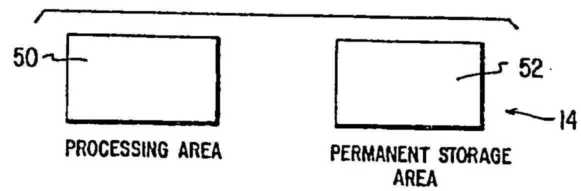



FIG. 4

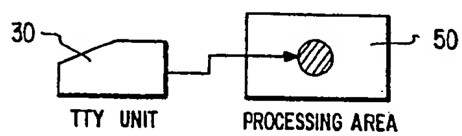



FIG. 5

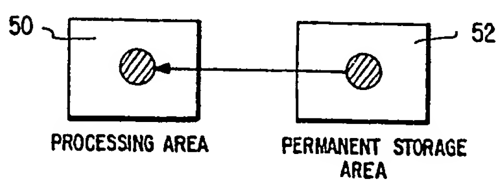
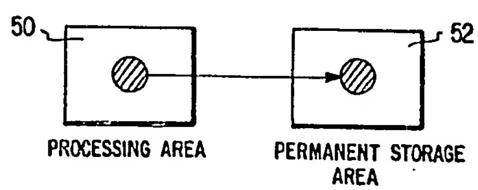



FIG. 6



MODEL 33 TELETYPEWRITER KEYBOARD AND CONTROLS

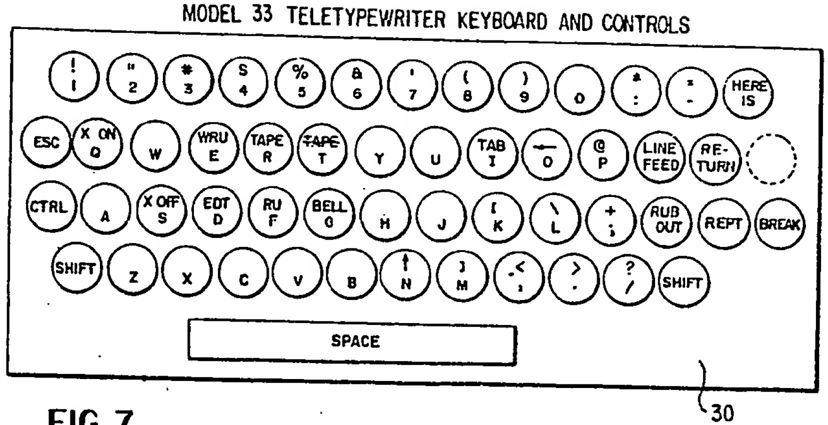
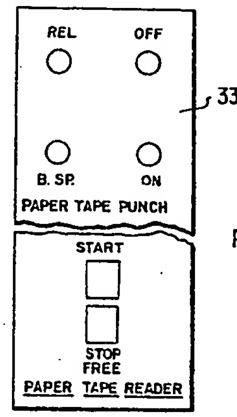



FIG. 7

FIG. 8



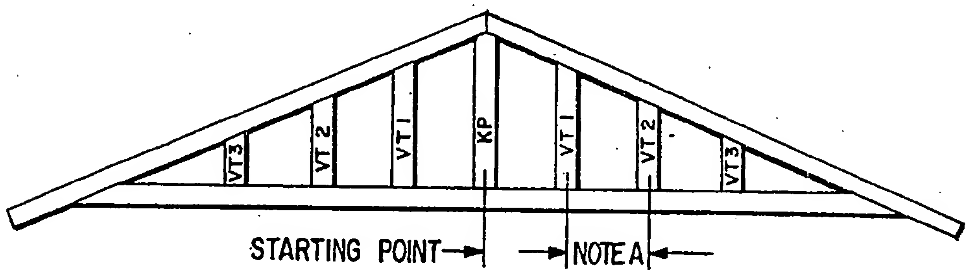

PAPER TAPE PUNCH
AND
READER CONTROLS

FIG. 9

| TYPE | SYMBOL | |
|---|---|---|
| TRUSSES: | | |
| FINK | F | I |
| HOWE | H | O |
| DOUBLE W (Belgian) | W | W |
| KING POST | K | P |
| GABLE ENDS: | | |
| FULL STUDS | G | E |
| TRIANGLE LOUVER | L | B |
| RECTANGLE LOUVER | L | G |
| DROPPED GABLE ENDS: | | |
| FULL STUDS | D | E |
| TRIANGLE LOUVER | D | B |
| RECTANGLE LOUVER | D | G |

GABLE ENDS

FIG. 11A




NOTE A: SPACING OF CENTER TO CENTER DIMENSIONS OF VERTICALS FROM KING POST IS BASED ON SPECIFICATION GIVEN IN USER'S FILE

FIG. 11B

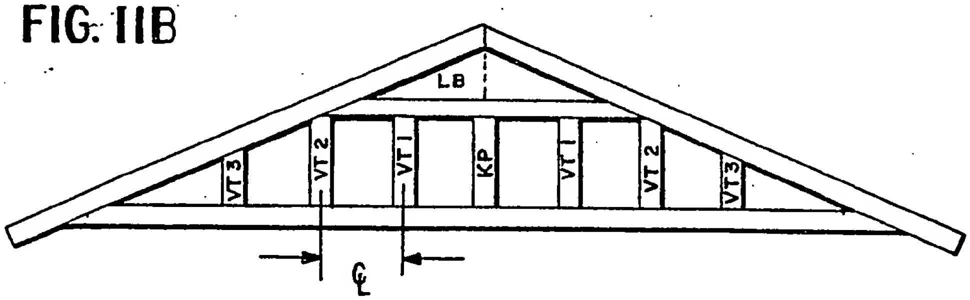



FIG. 11C

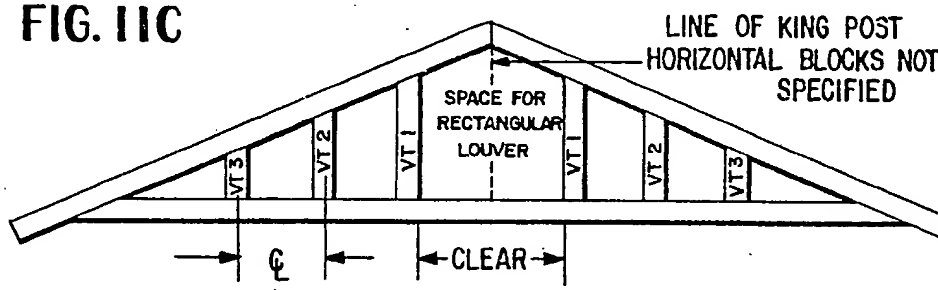


FIG. 12A

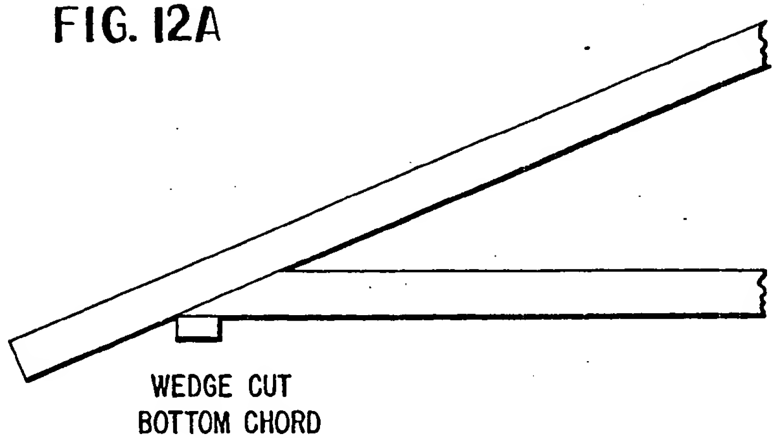



FIG. 12B

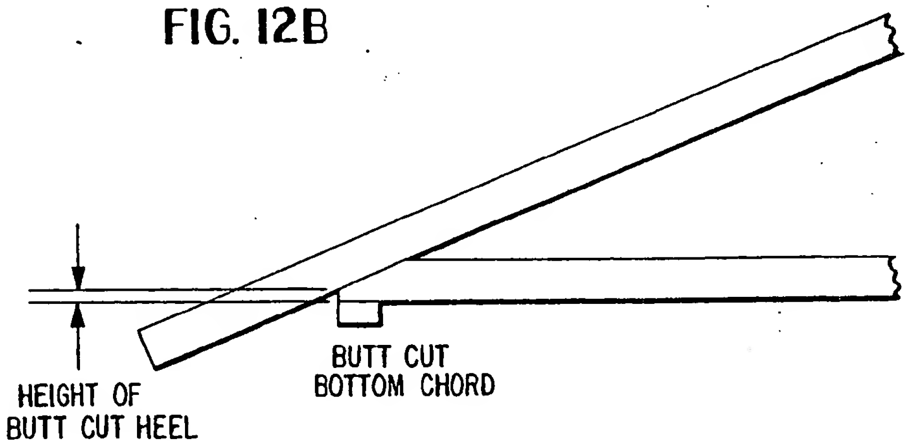
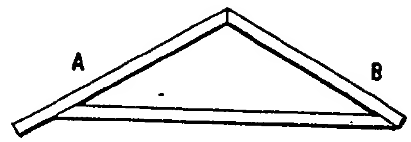


FIG. 14A

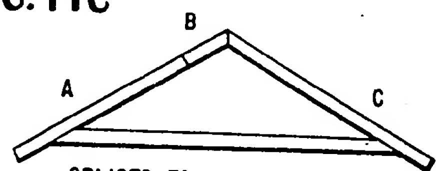

EQUAL OVERHANGS
NO SPLICES

FIG. 14B



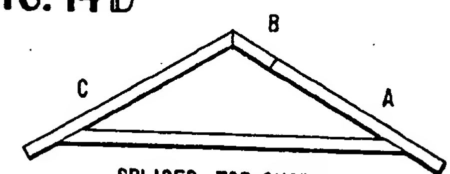

UNEQUAL OVERHANGS
NO SPLICES

FIG. 14C



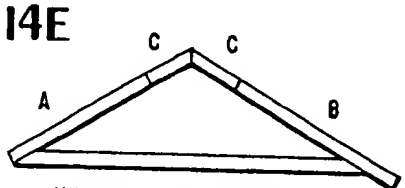

SPLICED TOP CHORD
LEFT SIDE

FIG. 14D



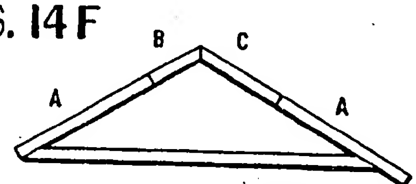

SPLICED TOP CHORD
RIGHT SIDE

FIG. 14E



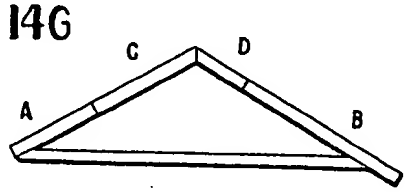

UNEQUAL TOP CHORDS
UPPER MEMBERS EQUAL LENGTH

FIG. 14F



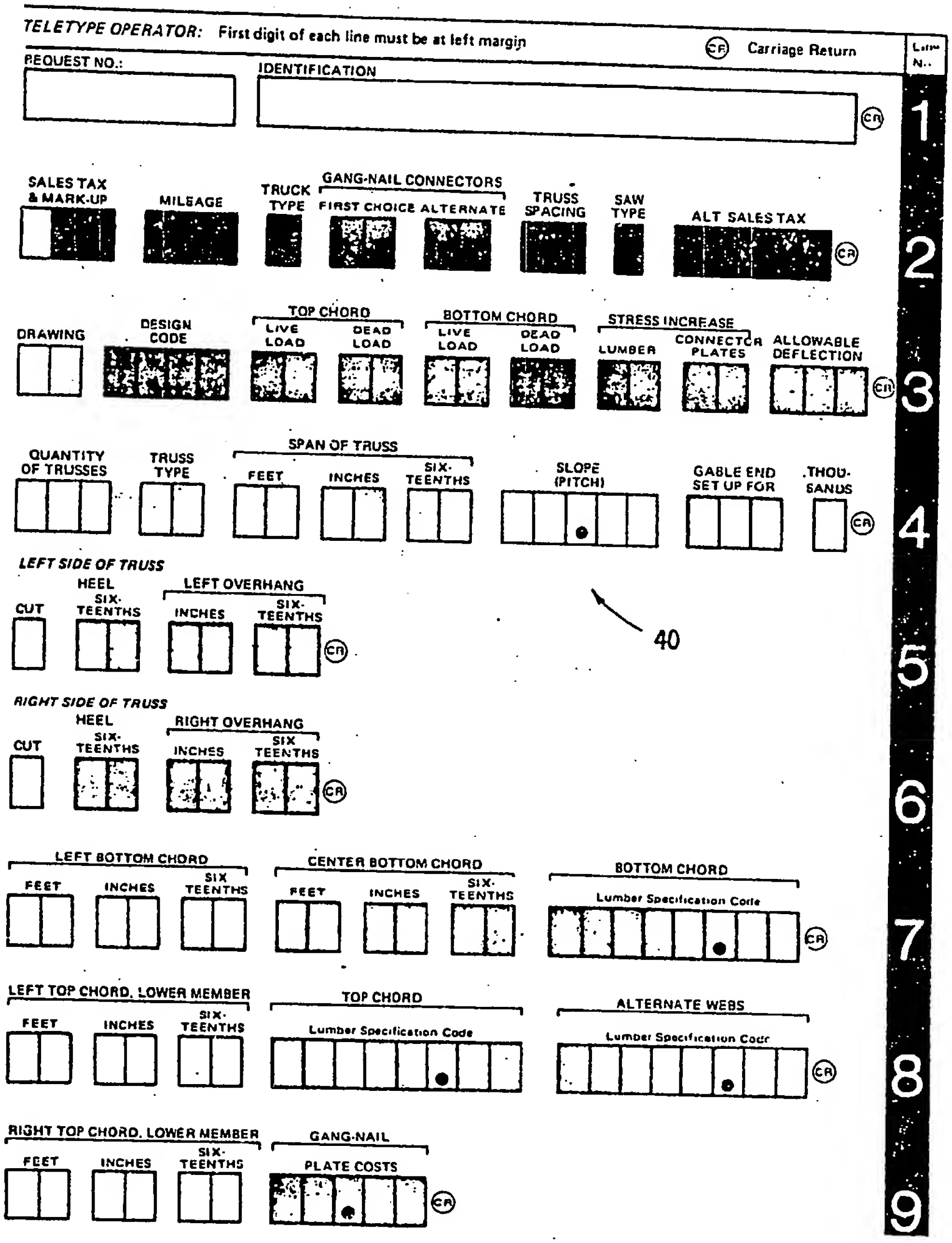

UNEQUAL TOP CHORDS
LOWER MEMBERS EQUAL LENGTH

FIG. 14G




ALL TOP CHORD MEMBERS
DIFFERENT LENGTHS

FIG. 16A


TELETYPE OPERATOR: First digit of each line must be at left margin
CR Carriage Return
REQUEST NO.:
IDENTIFICATION
1
SALES TAX & MARK-UP
MILEAGE
TRUCK TYPE
GANG-NAIL CONNECTORS
FIRST CHOICE
ALTERNATE
TRUSS SPACING
SAW TYPE
ALT SALES TAX
2
DRAWING
DESIGN CODE
TOP CHORD
LIVE LOAD
DEAD LOAD
BOTTOM CHORD
LIVE LOAD
DEAD LOAD
STRESS INCREASE
LUMBER
CONNECTOR PLATES
ALLOWABLE DEFLECTION
3
QUANTITY OF TRUSSES
TRUSS TYPE
SPAN OF TRUSS
FEET
INCHES
SIX-TEENTHS
SLOPE (PITCH)
GABLE END SET UP FOR
THOU-SANDS
4
LEFT SIDE OF TRUSS
HEEL
CUT
SIX-TEENTHS
LEFT OVERHANG
INCHES
SIX-TEENTHS
40
5
RIGHT SIDE OF TRUSS
HEEL
CUT
SIX-TEENTHS
RIGHT OVERHANG
INCHES
SIX TEENTHS
6
LEFT BOTTOM CHORD
FEET
INCHES
SIX TEENTHS
CENTER BOTTOM CHORD
FEET
INCHES
SIX-TEENTHS
BOTTOM CHORD
Lumber Specification Code
7
LEFT TOP CHORD, LOWER MEMBER
FEET
INCHES
SIX-TEENTHS
TOP CHORD
Lumber Specification Code
ALTERNATE WEBS
Lumber Specification Code
8
RIGHT TOP CHORD, LOWER MEMBER
FEET
INCHES
SIX-TEENTHS
GANG-NAIL
PLATE COSTS
9

*This drawing is a reproduction of the Original on a reduced scale.*



# FIG. 17

60

TOP CHORD 1-B 2-C

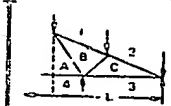
BOT. CHORD 4-A 3-C

WEBS A-B B-C

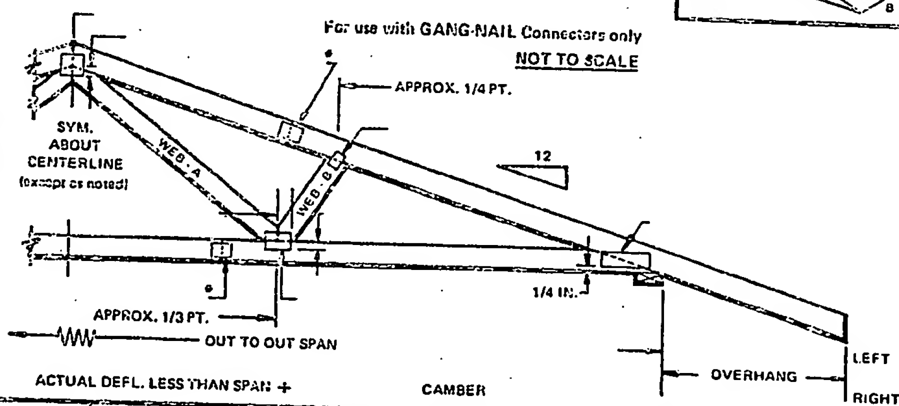
FORCE (LBS.)

REACTION (LBS.)

NOTE: MINUS IS COMPRESSION








ACTUAL DEFL. LESS THAN SPAN ÷

CAMBER

| FINK TRUSS | SLOPE | SPAN | SPACING |
|---|---|---|---|

SIZE — LUMBER - GRADE AND SPECIES — LIVE LOAD — DEAD LOAD — PSF

TC
BC
WEBS

TOP CHORD
BOTTOM CHORD
WEBS

GANG-NAIL VALUES: (LBS. PER NAIL)

APPROVED VALUES - REPORT

ALLOWABLE STRESS INCREASE:

LUMBER - LOAD DURATION FACTOR
NAILS - LOAD DURATION FACTOR
REPETITIVE MEMBER VALUE, ALS. PS-20-70 (BENDING ONLY)

**HANDLING AND BRACING:**

Care shall be exercised at all times to avoid damage, through careless handling, during unloading, storing and erecting.

Erection bracing shall be installed to hold the truss true and plumb and in safe condition until permanent truss bracing and other permanent components, such as purlins and/or sheathing, contributing to the rigidity of the complete roof structure, are in place. All erection and permanent bracing shall be completely installed and all components permanently fastened into place before the application of any loa . except the weight of the erectors.

Any lateral bracing specified hereon is for bracing individual truss members in compression. *Additional bracing for the overall structure may be required (see building designer).*

DESIGN SPECIFICATIONS: This design is in accordance with: "National Design Specifications For Stress Grade Lumber And Its Fastenings" NFPA.

NOTES:

1. Install plates in pairs, one on each side of joint.
2. Locate plates symmetrically on joint, except where positioning dimensions are shown.
3. All joints shall be tight fitting and jigged firmly in place during pressing of plates

GANG-NAIL HARDWARE SPECIFICATIONS:

Manufactured by Automated Building Components, Inc., from galvanized steel that meets or exceeds ASTM A446-67

Ultimate Strength = 48,000 psi
Yield Strength = 33,000 psi

Plates must bear the registered Gang Nail trademark.

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OLD, DRAW READY - LNH (F)

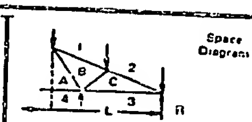
64

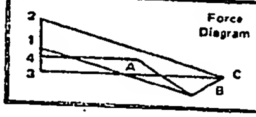
# FIG. 19

60

| TOP CHORD | | BOT. CHORD | | WEBS | | |
|---|---|---|---|---|---|---|
| 1-B | 2-C | 4-A | 3-C | A-B | B-C | |
| -1695 | -1933 | 1169 | 1729 | 644 | -404 | FORCE (LBS.) |

REACTION (LBS.) NOTE: MINUS IS COMPRESSION

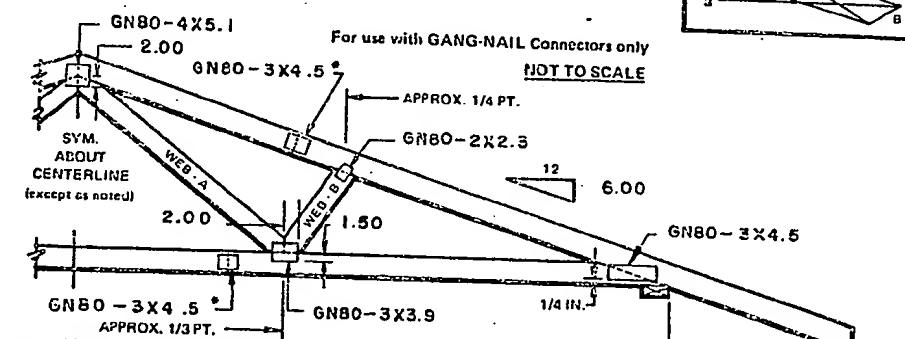



* SPLICE WITHIN 9 IN. OF 1/4 PANEL LENGTH FROM JOINT.

For use with GANG-NAIL Connectors only

NOT TO SCALE




OUT TO OUT SPAN 30 FT 0 IN 0 SX — 12 IN 0 SX LEFT

OVERHANG

24 IN 0 SX RIGHT

ACTUAL DEFL. LESS THAN SPAN ÷ 360 CAMBER 0-1/8 IN

| FINK TRUSS | SLOPE 6.00/12 | SPAN 30 FT 0 IN 0 SX | 24 IN SPACING |
|---|---|---|---|

| | SIZE | LUMBER - GRADE AND SPECIES | LIVE LOAD | DEAD LOAD | PSF |
|---|---|---|---|---|---|
| TC | 2 X 4 | NO. 1 KD SO. PINE | 20 | 10 | TOP CHORD |
| BC | 2 X 4 | NO. 1 KD SO. PINE | 0 | 10 | BOTTOM CHORD |
| WEBS | 2 X 4 | NO. 2 HEM-FIR | ---- | ---- | WEBS |

GANG-NAIL VALUES: (LBS. PER NAIL)

| | |
|---|---|
| GN80 | 34 |
| GN40 | 84 |

LOC 3 APPROVED VALUES - REPORT

ALLOWABLE STRESS INCREASE:

25 % LUMBER - LOAD DURATION FACTOR
0 % NAILS - LOAD DURATION FACTOR
15 % REPETITIVE MEMBER VALUE, ALS: PS-20-70 (BENDING ONLY)

HANDLING AND BRACING:
Care shall be exercised at all times to avoid damage, through careless handling, during unloading, storing and erecting.
Erection bracing shall be installed to hold the truss true and plumb and in safe condition until permanent truss bracing and other permanent components, such as purlins and/or sheathing, contributing to the rigidity of the complete roof structure, are in place. All erection and permanent bracing shall be completely installed and all components permanently fastened into place before the application of any load, except the weight of the erectors.
Any lateral bracing specified hereon is for bracing individual truss members in compression. *Additional bracing for the overall structure may be required (see building designer).*

DESIGN SPECIFICATIONS: This design is in accordance with: "National Design Specifications For Stress Grade Lumber And Its Fastenings" NFPA,

DESIGN SPECIFICATION FOR LIGHT METAL PLATE CONNECTED WOOD TRUSSES, TPI, 1970

NOTES:
1. Install plates in pairs, one on each side of joint.
2. Locate plates symmetrically on joint, except where positioning dimensions are shown.
3. All joints shall be tight fitting and jigged firmly in place during pressing of plates.

ABCOM SYSTEMS
P.O. BOX 5147
CHARLOTTESVILLE, VA.
22903

REQUEST A 102 30 FINK 30-0 6-12 10 OHIE 2-0 OHIE

GANG-NAIL HARDWARE SPECIFICATIONS:
Manufactured by Automated Building Components, Inc., from galvanized steel that meets or exceeds ASTM A446-67
Ultimate Strength = 48,000 psi
Yield Strength = 33,000 psi
Plates must bear the registered Gang Nail trademark.

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VA 66